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of

*Edwin J. Hall
Victor H. Shear
Luke S. Tomasello
David M. Van Wie
Robert P. Weber
Kim Worsencroft
and
Xeujun Xu*

for

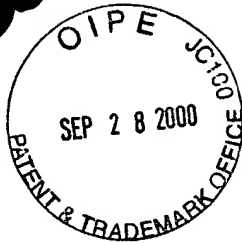
*Techniques for Defining, Using and Manipulating
Rights Management Data Structures*

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FINNEGAN, HENDERSON,
FARABOW, GARRETT
& DUNNER, L.L.P.
STANFORD RESEARCH PARK
700 HANSEN WAY
PALO ALTO, CALIF. 94304
650-849-6600



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**TECHNIQUES FOR DEFINING, USING AND
MANIPULATING RIGHTS MANAGEMENT DATA
STRUCTURES**

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Cross-Reference to Related Applications

This application is related to commonly assigned co-pending
application serial no. 08/388,107 of Ginter et al. entitled "SYSTEMS
AND METHODS FOR SECURE TRANSACTION

MANAGEMENT AND ELECTRONIC RIGHTS PROTECTION,"

now abandoned

10 filed on February 13, 1995; and pending application serial no.

08/699,712 of GINTER et al. entitled "TRUSTED

INFRASTRUCTURE SUPPORT SYSTEMS, METHODS AND

TECHNIQUES FOR SECURE ELECTRONIC COMMERCE

ELECTRONIC TRANSACTIONS AND RIGHTS

now abandoned

15 MANAGEMENT" filed on 12 August 1996. The entire disclosures,

including the drawings, of those prior filed specifications are

incorporated by reference into this application.

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Field of the Invention

This invention relates to techniques for defining, creating, and manipulating rights management data structures. More specifically, this invention provides systems and processes for defining and/or
5 describing at least some data characteristics within a secure electronic rights management container. The present invention also provides techniques for providing rights management data structure integrity, flexibility, interoperability, user and system transparency, and compatibility.

10 Background and Summary of the Invention(s)

People are increasingly using secure digital containers to safely and securely store and transport digital content. One secure digital container model is the "DigiBox™" container developed by InterTrust Technologies Corp. of Sunnyvale California. The Ginter
15 et al. patent specification referenced above describes many characteristics of this DigiBox™ container model -- a powerful, flexible, general construct that enables protected, efficient and interoperable electronic description and regulation of electronic commerce relationships of all kinds, including the secure transport,

storage and rights management interface with objects and digital information within such containers.

Briefly, DigiBox containers are tamper-resistant digital containers that can be used to package any kind of digital information

5 such as, for example, text, graphics, executable software, audio and/or video. The rights management environment in which DigiBox™ containers are used allows commerce participants to associate rules with the digital information (content). The rights management environment also allows rules (herein including rules

10 and parameter data controls) to be securely associated with other rights management information, such as for example, rules, audit records created during use of the digital information, and administrative information associated with keeping the environment working properly, including ensuring rights and any agreements

15 among parties. The DigiBox™ electronic container can be used to store, transport and provide a rights management interface to digital information, related rules and other rights management information, as well as to other objects and/or data within a distributed, rights management environment. This arrangement can be used to provide

an electronically enforced chain of handling and control wherein rights management persists as a container moves from one entity to another. This capability helps support a digital rights management architecture that allows content rightsholders (including any parties

5 who have system authorized interests related to such content, such as content republishers or even governmental authorities) to securely control and manage content, events, transactions, rules and usage consequences, including any required payment and/or usage reporting. This secure control and management continues

10 persistently, protecting rights as content is delivered to, used by, and passed among creators, distributors, repurposers, consumers, payment disagregators, and other value chain participants.

For example, a creator of content can package one or more pieces of digital information with a set of rules in a DigiBox secure

15 container -- such rules may be variably located in one or more containers and/or client control nodes -- and send the container to a distributor. The distributor can add to and/or modify the rules in the container within the parameters allowed by the creator. The distributor can then distribute the container by any rule allowed (or

not prohibited) means – for example, by communicating it over an electronic network such as the Internet. A consumer can download the container, and use the content according to the rules within the container. The container is opened and the rules enforced on the

5 local computer or other InterTrust-aware appliance by software InterTrust calls an InterTrust Commerce Node. The consumer can forward the container (or a copy of it) to other consumers, who can (if the rules allow) use the content according to the same, differing, or other included rules -- which rules apply being determined by user

10 available rights, such as the users specific identification, including any class membership(s) (e.g., an automobile club or employment by a certain university). In accordance with such rules, usage and/or payment information can be collected by the node and sent to one or more clearinghouses for payment settlement and to convey usage

15 information to those with rights to receive it.

The node and container model described above and in the Ginter et al. patent specification (along with similar other DigiBox/VDE (Virtual Distribution Environment) models) has nearly limitless flexibility. It can be applied to many different contexts and

specific implementations. For example, looking at Figures 1A and 1B, a newspaper publisher can distribute a newspaper 102 within a container 100A. A publisher of fashion magazines 106 can distribute the fashion magazines within another container 100C. Similarly, for
5 example, a wholesale banking environment may use yet a further container, an electronic trading system may use a still further container, and so on.

The InterTrust DigiBox container model allows and facilitates these and other different container uses. It facilitates detailed
10 container customization for different uses, classes of use and/or users in order to meet different needs and business models. This customization ability is very important, particularly when used in conjunction with a general purpose, distributed rights management environment such as described in Ginter, et al. Such an environment
15 calls for a practical optimization of customizability, including customizability and transparency for container models. This customization flexibility has a number of advantages, such as allowing optimization (e.g., maximum efficiency, minimum overhead) of the detailed container design for each particular

application or circumstance so as to allow many different container designs for many different purposes (e.g., business models) to exist at the same time and be used by the rights control client (node) on a user electronic appliance such as a computer or entertainment device.

5 While supporting a high degree of flexibility has great advantages, it can produce difficulties for the average user. For example, think of the process of creating a painting. A master painter creates a painting from a blank canvas. Because the canvas was blank at the beginning, the painter was completely unconstrained.

10 The painting could have been a landscape, a portrait, a seascape, or any other image -- limited only by the painter's imagination. This flexibility allows a master painter to create a masterpiece such as the "Mona Lisa." However, great skill is required to create a pleasing image starting from a blank canvas. As a result, an inexperienced
15 painter cannot be expected to create a good painting if he or she begins with a blank canvas.

Consider now an amateur painter just starting out. That person does not have the skill to transform a blank canvas to a pleasing

image. Instead of spending years trying to acquire that skill, the amateur can go out and buy a "paint by numbers" painting kit. Instead of using a blank canvas, the amateur painter begins with a preprinted canvas that defines the image to be painted. By following
5 instructions ("all areas labeled "12" should be painted with dark red," "all areas labeled with "26" should be painted with light blue"), the amateur can – with relatively little skill – paint a picture that is relatively pleasing to the eye. To do this, the amateur must rigidly adhere to the preprinted instructions on the canvas. Any deviations
10 could cause the final image to come out badly.

Ease of use problems in the computer field can be analogized to the "paint by numbers" situation. If it is important for untrained and/or inexperienced users to use particular software, the system designers can predefine certain constructs and design them into the
15 system. This technique allows inexperienced users to make use of potentially very complicated designs without having to fully understand them – but this normally strictly defines, that is severely limits, the functionality and flexibility available by use of the program. As a result, creative solutions to problems are constrained

in order to provide practical value. In addition, even the experienced user can find great advantage in using previously implemented designs. Because a user can program a complex program, for example, does not mean it is appropriate or efficient to create a

5 program for a specific purpose, even if the previously implemented program is not ideal. If the creation of a new program "costs" more to create, that is takes too much time or financial resources, the experienced user will normally use a previously implemented program, if available. Therefore, the greatest total amount of value to

10 be realized, related to customization, is to be able to customize with great ease and efficiency so that the cost of customization will not exceed the benefits.

Uniformity, flexibility, compatibility and interoperability are other considerations that come into play in the computer field,

15 particularly in regards to systems supporting customization. In the painting situation, the human eye can appreciate uniqueness – and the "one of a kind" nature of a masterpiece such as the Mona Lisa is a big part of what makes a painting so valuable. In contrast, it is often desirable to make uniform at least the overall layout and format of

things in the computer field. It is much more efficient for a computer to know beforehand how to treat and use objects. If the computer doesn't know beforehand how to read or handle an input object, for example, then the computer and the object are said to be

5 "incompatible", i.e., they cannot work together. Computers are said to be "interoperable" if they can work together. Incompatibility and interoperability problems can prevent one computer from talking to another computer, and can prevent you from using computer data created by someone else.

10 For example, in the non-computer world, a Frenchman who knows only a little English as a second language, might find it far more meaningful and efficient to describe a complex problem in his native tongue, French. But if he is speaking to a second person, an Englishman, and the Englishman does not understand French, the two
15 are not interoperable in French, and the Frenchman must resort to the far less efficient option of speaking in English to the Englishman. Of course, this is far better than if he was trying to speak to a German who understood neither English nor French. Then the two would be not be "interoperable" in regards to discussing the problem.

Similarly, because rights management containers may potentially be exchanged and used for a large number of different purposes by a large number of different users, groups, and organizations, it is very important to provide compatibility and interoperability if these different parties, each participating in one or more different rights management models, are to interoperate efficiently. For example, if a rights management container is used to distribute a newsletter and is optimized for this purpose, each reader of the newsletter must have a computer system or software that “knows” how to read the container and the newsletter it contains. Since commerce, such as distributing newsletters, needs to be as efficient and cost-effective as is feasible, it is important to optimize, that is customize, rights management containers to optimally reflect the requirements of their models and not to have unnecessary features for each respective application or class of application, since unnecessary features will require unnecessary computing overhead and/or storage space.

Different newsletter publishers may use different container formats customized to their own particular newsletters and/or content types and/or formats. A newsletter reader interested in many

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different newsletters may need to be able to read a large number of different formats. It normally will not efficient (or, due to security issues, may not be appropriate) simply to analyze the different containers upon delivery and "try to figure out" or otherwise discern
5 the particular format in use.

Published standards may help achieve a level of interoperability and standards for given types of applications, but it generally takes a long time for any particular standard to achieve industry-wide acceptance and standards will need to vary widely
10 between categories of applications. Moreover, data structure and other standards are often designed to the lowest common denominator -- that is, they will carry fields and requirements not needed by some, and miss others features optimal in certain cases. There will always be applications that cannot be optimized for
15 efficiency and/or operation if forced to use a specific standard.

Trade-offs between flexibility, ease of use and incompatibility and interoperability can be further complicated when security considerations come into play. To be effective in many electronic

commerce applications, electronic container designs should be
tamper-resistant and secure. One must assume that any tools widely
used to create and/or use containers will fall into the hands of those
trying to break or crack open the containers or otherwise use digital
5 information without authorization. Therefore, the container creation
and usage tools must themselves be secure in the sense that they must
protect certain details about the container design. This additional
security requirement can make it even more difficult to make
containers easy to use and to provide interoperability.

10 The above-referenced Ginter et al. patent specification
describes, by way of non-exhaustive example, "templates" that can
act as a set (or collection of sets) of control instructions and/or data
for object control software. See, for example, the "Object Creation
and Initial Control Structures," "Templates and Classes," and "object
15 definition file," "information" method and "content" methods
discussions in the Ginter et al. specification. The described templates
are, in at least some examples, capable of creating (and/or modifying)
objects in a process that interacts with user instructions and provided
content to create an object. Ginter et al. discloses that templates may

shorthand abstract representation of the format of the data within a rights management related data structure. This abstract data representation can be used to describe a single rights management data structure, or it may be generic to a family of data structures all following the format and/or other characteristics the abstract representation defines. The abstract representation may be used to create rights management data structures, allow others (including "other" rights management nodes automatically) to read and understand such data structures, and to manipulate some or all of the data structures.

The descriptive data structure can be used as a "template" to help create, and describe to other nodes, rights management data structures including being used to help understand and manipulate such rights management data structures.

In one particularly advantageous arrangement, the machine readable descriptive data structure may be associated with one or a family of corresponding rights management data structures – and may thus be independent of any specific particular rights

management data structure usage. For example, a copy of the descriptive data structure may be kept with such data structures. Alternatively, some or all of the descriptive data structure may be obtained from somewhere else (e.g., a clearinghouse or repository) and independently delivered on as-needed basis.

In accordance with one example, the machine readable descriptive data structure provides a description that reflects and/or defines corresponding structure(s) within the rights management data structure. For example, the descriptive data structure may provide a recursive, hierarchical list that reflects and/or defines a corresponding recursive, hierarchical structure within the rights management data structure. In other examples, the description(s) provided by the descriptive data structure may correspond to complex, multidimensional data structures having 2, 3 or n dimensions. The descriptive data structure may directly and/or indirectly specify where, in an associated rights management data structure, corresponding defined data types may be found. The descriptive data structure may further provide metadata that describes one or more attributes of the corresponding rights management data and/or the

processes used to create and/or use it. In one example, the entire descriptive data structure might be viewed as comprising such metadata.

The machine readable descriptive data structure may or may not be, in part or in whole, protected, depending on the particular application. Some machine readable descriptive data structures may be encrypted in whole or in part, while others might be maintained in "clear" form so that they are easily accessible. Some machine readable description data structures, whether encrypted or not, may be in part or wholly protected for integrity using a cryptographic hash algorithm in combination with a secrecy algorithm to form a cryptographic seal, and/or through use of other protection techniques (including hardware, e.g., secure semiconductor and/or hardware packaging protection means). The machine readable descriptive data structures may themselves be packaged within rights management data structures, and rules (e.g., permissions records) controlling their access and use may be associated with them

In accordance with one aspect of how to advantageously use descriptive data structures in accordance with a preferred embodiment of this invention, a machine readable descriptive data structure may be created by a provider to describe the layout of the provider's particular rights management data structure(s) such as secure containers. These descriptive data structure ("DDS") templates may be used to create containers. A choice among two or more possible DDSs may be based upon one or more classes and/or one or more classes may be based on parameter data. The DDS may be loaded and used as the layout rules for secure containers being created. The provider can keep the DDS private, or publish it so that other providers may create compatible, interoperable containers based on the same DDS.

Descriptive data structures can also be used by a container viewer, browser, reader, or any other end user application designed to work with containers. Truly generic viewers or other applications can be written that can process a container in any format at least in part by making use of descriptive data structures. Thus, a descriptive data structure can be used to at least temporarily convert and/or

customize a generic viewer (or other application) into a specialized viewer (or other application) optimized around one or more classes of containers. Additionally, specialized readers may be provided to efficiently process descriptive data structures to locate key media elements (e.g., cover page, table of contents, advertiser's index, glossary, articles, unprotected preview, price, and/or rights information regarding viewing, printing, saving electronically, redistributing, related budgets and/or other parameter information, etc.).

Such specialized readers can then seamlessly, transparently, and automatically process to present the user with an easy-to-use interface (for example, an icon display for each of the key media elements) optimized for the specific application, container, and/or user. Different and/or differently presented, such elements may be displayed or otherwise employed based, for example, on the identity of the user and/or user node, including, for example, taking into account one or more class attributes which can influence such automated processing.

Two or more DDSs may be associated with a container and/or container contents, as well as, for example, one or more user and/or node classes. A choice among two or more possible DDSs for a given container and/or class of containers and/or container contents may

5 therefore be based upon one or more classes and/or one or more classes based on parameter data. Overall, this ability to easily characterize, and/or reuse stored, optimized, custom container models and subsequent transparency of translation from such customized containers (e.g.. specific DDSs) to general purpose rights

10 management use is particularly useful. For example, where such customized DDSs can be used as a basis for the creation of customized, optimized display of container content and/or control information to substantially improve the ease of use, efficiency, transparency, and optimization of a distributed, generalized rights

15 management environment. In such an environment, for example, user nodes can interact with different DDSs to automatically adjust to the requirements of the commercial or other rights models associated with such DDSs.

Some providers may spend considerable time designing sophisticated container descriptive data structures that describe the layout of their associated containers. With this type of investment in structure and format, the descriptive data structure will often have

5 significant value in their reuse for the same or similar applications.

Entities can use descriptive data structures in-house to ensure consistent and highly efficient creation of containers. Third party providers (i.e., a provider other than the one responsible for descriptive data structure creation) can use these descriptive data

10 structures when they wish to create containers compatible with other entities. One example is where the publisher of a widely circulated newspaper develops a descriptive data structure for reading its newspaper. Other, smaller newspapers may want to leverage any viewers or other tools put in place for use with the widely circulated

15 newspaper by adopting the same container format. Descriptive data structures can be copyrighted and/or otherwise protectable by both law and by the rights management system itself. For example, they may also be protected by their own containers and associated controls to ensure that descriptive data structure creators, and/or distributors

and/or other users of such DDSs, receive their fair, rights system managed, return on their descriptive data structure creation and/or use related efforts.

In addition to the foregoing, the following is a list of features and advantages provided in accordance with aspects of this invention:

- Integrity Constraints: The descriptive data structure allows the provider to protect the integrity of his or her content, by enabling the specification of integrity constraints. Integrity constraints provide a way to state integrity related rules about the content.
 - Application Generation: The descriptive data structure can be used to generate one or more portions of software programs that manipulate rights management structures.
- For example, a descriptive data structure could serve as 'instructions' that drive an automated packaging application for digital content and/or an automated reader of digital

content such as display priorities and organization (e.g., order and/or layout).

- Dynamic user interfaces for creation applications:

Applications can read a descriptive data structure to generate an interface optimized for data creation, editing, and/or composition for a specific model, including models involving, for example, composing complex content from textual, audio, video, and interactive (e.g., querying) elements. The data may take the form of a container, database and/or any other digital information organization as any simple or compound and complex file format. Applications can also read a descriptive data structure to learn how to best display an interface for collection and/or creation of content.

- Dynamic user interfaces for display applications:

Applications can read a descriptive data structure to and generate an interface appropriate for data display. This data may be a container, database or any other compound

complex file format. Applications can also read a
descriptive data structure to learn how to best display an
interface for the presentation of content. Applications can
further read a descriptive data structure to learn how to
manage display functions related to interacting -- for
content creation and/or packaging and/or user display
purposes including optimizing any of such interactions --
with other one or more other applications, smart agents,
computing environments, identity (including any class
identities) of user and/or user nodes, etc. For example, a
user interface might be differently optimized for interacting
with: a member of the U. S. Air Force versus a faculty
member in social sciences at a university; or a member of a
Kiwanis Club versus a member of a Protestant church club,
a citizen of the United States versus a citizen of Saudia
Arabia, including an appropriate display of expected class
membership symbols and related, appropriate organization
or suppression of displayed information.

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• Ability to automatically identify and locate data fields: Full text search, agents, web spiders, and the like, benefit and are able to interact with information contained within one or more areas of a DDS when areas within a data file are known to contain potentially interesting information and such information is presented in a predefined format.
- 10

• Ability to extract needed or desired data without first-hand knowledge of data format: Full text search, agents, web spiders, and the like, benefit and are able to interact with information contained within one or more areas of a DDS when large data files of arbitrary complexity and of unknown origin can be processed without special knowledge.
- 15

• Efficient, machine/human readable data abstract: The descriptive data structures can be optimally small, convenient, and cost-effective to process, transmit, and/or store.

- Reusable, salable – independent of actual data: Descriptive data structures may be arbitrarily complex and therefore potentially time consuming to construct and requiring certain expertise. This gives the descriptive data structure resale value.

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- On-the-fly definition and redefinition of content layout: Working with a layout tool allows quick iterations (including editing and modifications) of a design (layout) which can be more convenient and cost-effective than creating such a layout, which also may be quite difficult or beyond the expertise of many users.

10

- Descriptive data structure attributes allow for meta-characteristics not found in actual data: Because the same descriptive data structure is processed by both the creation and post-creation processes, meta-information can be placed into the descriptive data structure that would otherwise be unavailable in the packaged content. One

15

example of this whether display of certain fields is
“Required” or “Hidden”.

- Enables design automation via descriptive data structure

“wizards”: Descriptive data structures themselves enable

5 further automation in the way of “wizards”. There can, for

example, be descriptive data structures that help to define

other descriptive data structures. Descriptive data

structures defining other descriptive data structures might

10 represent the incomplete descriptive data structure for a

book or magazine, for example. The “wizard” can comprise

a series of dialog boxes displayed to the user to fill in the

missing information to make it a completed descriptive data

structure.

- Applications outside of a particular rights management

15 architecture: For example, polymorphous applications may

use descriptive data structures to determine certain data

visualizations attributes and/or requirements, such as what

look and feel should be displayed to the user. For example,

if a descriptive data structure contains a word processing document reference, the polymorphous application might create an interface appropriate for display and editing of a document. If the descriptive data structure contains references to many executable programs, the polymorphous application might ask the user where the files should be saved.

- Enables umbrella applications to process descriptive data structures and delegate unknown file types and processes:

Umbrella (or polymorphous) applications can, for example, act substantially as an operation for a particular data file.

This umbrella application may extract and process those things in the data file that it cares about, while ignoring or delegating (to, for example, user and/or value chain partner (e.g., distributor) to control display of such items) those things it does not understand.

- Runtime interpretation: It is possible to interpret a descriptive data structure at run time, providing materially increased efficiencies and timeliness.
- 5 • Runtime adaptability: Systems can adapt to dynamic data arriving in real time through use of descriptive data structures.
- Automatic conversion capability: Descriptive data structures be used for converting automatically from one format to another.
- 10 • Simplified system design: The use of descriptive data structures may greatly reduce the need for a secondary “wrapper” application programming interface (API) or other arrangement to securely “contain” the container creation process. Such a “wrapper” API to control and
- 15 otherwise restrict the container creation process might otherwise be needed to ensure that all created containers are compatible – thereby limiting flexibility and the ability to customize.

- 5

• Object oriented template programming environment: The use of display related, interaction related, and rights related concept objects which may be selected through high-level user interface choices and prioritizations and specification of related parameter data, this enabling very easy creation of certain categories of templates – such as construction and display hint information.
- 10

• The use of a template language and interpreter involving supporting programming through use of language elements and interpretation of such language by nodes described in Ginter, et al., where such language includes elements descriptive of display, rights, and program interaction elements, priorities and parameter data.

Brief Description of the Drawings

15 These and other features and advantages of presently preferred example embodiments in accordance with the invention may be better and more completely understood by referring to the following detailed description along with the drawings, of which:

Figures 1A and 1B show example content containers;

Figures 2A and 2B show example content containers
associated with example descriptive data structures;

Figure 3 shows an example descriptive data structures creation
5 and usage process;

Figure 4 shows another example creation and usage process;

Figure 5 shows an example system architecture using
descriptive data structures;

Figure 5A shows an example process performed by the Figure
10 5 system;

Figure 6 shows an hierarchical descriptive data structure
organization;

Figure 6A shows an example of how descriptive data structures
can be used with atomic transaction data;

15 Figure 7 shows an example descriptive data structure format;

Figure 8 shows an example descriptive data structure creation graphical interface;

Figure 9 shows an example process for tracking descriptive data structure rights management related data;

5 Figure 10A shows an example use of descriptive data structures to provide interoperability between environments; and

Figure 10B provides more detail about how the Figure 10A example descriptive data structure may be organized.

10 **Detailed Description of Presently Preferred Example Embodiments**

Figures 2A and 2B show the example containers 100a, 100c of Figures 1A, 1B associated with machine readable descriptive data structures 200 and 200'. Referring to Figure 2A, a descriptive data structure 200 is associated with content container 100a. This
15 descriptive data structure 200 may be used to define the content (and certain other characteristics) of container 100a. In the example shown, descriptive data structure 200 defines a number of sections of newspaper style content 102 such as, for example, the headline

(descriptor 202a), the issue date (descriptor 202b), the lead story (descriptor 202c), breaking news (descriptor 202d), image(s) (descriptor 202e), advertisement (descriptor 202f), and section (descriptor 202g).

5 The descriptive data structure definitions 202 in this example do not contain or specify the particular contents of corresponding portions of the newspaper 102, but instead define more abstractly, a generic format that a newspaper style publication could use. For example, the Figure 2A example descriptive data structure headline
10 definition 202a does not specify a particular headline (e.g., "Yankees Win the Pennant!"), but instead defines the location (for example, the logical or other offset address) within the container data structure 100a (as well as certain other characteristics) in which such headline information may reside. Because descriptive data structure 200 is
15 generic to a class or family of newspaper style content publications, it can be reused. For example, each daily issue of a newspaper might be created using and/or associated with the same descriptive data structure 200. By abstractly defining the data format and other characteristics of newspaper style content 102, the descriptive data

structure 200 allows easy creation, usage and manipulation of newspaper style content 102.

Referring to Figure 2B, a different descriptive data structure 200' may be used to define another class of content publications 106 such as fashion magazines. The descriptive data structure 200' for this content class reflects a different format (and possibly other characteristics) as compared to the descriptive data structure 200 shown in Figure 2A. For example, since fashion magazines typically do not include headlines or breaking news, the example descriptive data structure 200' may not define such formatting. Instead, descriptive data structure 200' for defining a class of fashion magazine content may define issue date (descriptor 204a), a magazine title (descriptor 204b), the name of a photographer (descriptor 204c) and associated artwork designation (descriptor 204d).

The Figure 2A and 2B examples show descriptive data structures 200, 200' being delivered within content object containers 100a, 100c along with associated content 102, 106. However, other

forms of association may be used. For example, descriptive data structure 200 can be independently delivered in its own separate container along with associated rules controlling its access and/or use. Alternatively, descriptive data structures 200 could be stored in
5 a library and delivered on an as needed basis in secure or insecure form depending on particular requirements.

In addition, although Figures 2A and 2B are printed publication content examples, the use of descriptive data structures 200 is not so limited. To the contrary, descriptive data structures 200
10 can be used to define the format and/or other characteristics associated with a wide variety of different types of digital information including for example:

- images
- sound
- 15 • video
- computer programs

- methods
 - executables
 - interpretables
 - currency objects
- 5
- currency containers for currency objects
 - rules
 - any computer input
 - any computer output
 - other descriptive data structures
- 10
- any other information.

Example Process For Creating and Using Descriptive Data Structures

Figure 3 shows an example process for creating and using descriptive data structures 200. In this example, a layout tool 300 is used to create descriptive data structure 200. This layout tool 300 may be, for example, a software-controlled process interacting with a

human being via a graphical user interface. The resulting descriptive data structure 200 (which may be stored on a mass storage device or other memory) can then be used to facilitate any number of other processes to create or interpret stored data. For example, the

- 5 descriptive data structure may be used in a creation process 302. The creation process 302 may read the descriptive data structure and, in response, create an output file 400 with a predefined format such as, for example, a container 100 corresponding to a format described by the descriptive data structure 200. A viewing process 304 may use
- 10 the descriptive data structure 200 to locate important items in the output file 400 for display. A browsing process 306 may use the descriptive data structure 200 to locate items within the stored output file 400 such as, for example, key words or other searchable text.
- Descriptive data structure 200 may supply integrity constraints or
- 15 rules that protect the integrity of corresponding content during use of and/or access to the content.

Figure 4 shows a more detailed example descriptive data structure creation and usage process. In this example, the layout tool 300 may accept user input 310 provided via a graphical user interface

312. The output of the layout tool 300 may be a descriptive data structure 200 in the form of, for example, a text file. A secure packaging process 302a may accept container specific data as an input, and it may also accept the descriptive data structure 200 as a read only input. The packager 302a could be based on a graphical user interface and/or it could be automated. The packager 302a packages the container specific data 314 into a secure container 100. It may also package descriptive data structure 200 into the same container 100 if desired. A viewer 304 may view data 314 with the assistance of the descriptive data structure 200 and in accordance with rules 316 packaged within the container applying to the data 314 and/or the descriptive data structure 200.

Example Architecture For Using Descriptive Data Structures

Figure 5 shows an example secure system architecture suitable for use with descriptive data structure 200. In this example, an electronic appliance 500 of the type described in the above-referenced Ginter et al. patent specification may be provided within a tamper resistant barrier 502. Electronic appliance 500 may include

an application program interface (API) 504. One or more applications 506 may communicate with electronic appliance 500 via API 504. In some examples, the application 506 may execute on the secure electronic appliance 500. Each application 506 may include a descriptive data structure interpreter 508. In use, electronic appliance 500 may access secure container 100 and – in accordance with rules 316 – access the descriptive data structure 200 and content 102 it contains and provide it to application 506. The interpreter 508 within application 506 may, in turn, read and use the descriptive data structure 200. In addition, application 506 may be polymorphic in the sense that it can take on personality or behavior as defined at least in part by descriptive data structure 200.

Figure 5A shows an example detailed process performed by the Figure 5 example secure system architecture. In this example, application 506 asks appliance 500 to retrieve the descriptive data structure 200 from container 100 (block 550). Electronic appliance 500 reads the descriptive data structure 200 and, subject to the conditions specified by associated rules 316, provides the descriptive data structure 200 to the application 506 (block 552). Application

506 then asks its interpreter 508 to interpret the descriptive data structure 200 (block 554). The interpreter 508 tells the application 506 what the descriptive data structure 200 says (block 556). The application 506 extracts or obtains the descriptive data structure information it needs or wants from interpreter 508 (block 558). For example, suppose the application 506 wants to display the "headline" information within newspaper style content shown in Figure 2A.

Application 506 may ask interpreter 508 to provide it with information that will help it to locate, read, format and/or display this "headline" information.

As another example, interpreter 508 may provide application 506 with an element identification (e.g., a hexadecimal value or other identifier) that corresponds to the headline information within the newspaper style content (block 558). Application 506 may then ask electronic appliance 500 to provide it with the Headline (or other) content information 102 within container 100 by providing appropriate content information to electronic appliance 500 via API 504 (block 560). For example, application 506 may pass the electronic appliance 500 the element ID that interpreter 508 provided

to the application. Even though application 506 may have no direct knowledge of what is inside container 100 (and may only be able to access the container 100 through a secure VDE node provided by appliance 500), interpreter 508 (by looking at descriptive data structure 200) can tell application 506 enough information so that the application knows how to request the information it wants from the electronic appliance 500.

The electronic appliance may then access information 102 within container 100, and deliver (in accordance with the rules 316 within the container) the requested information to the application 506 (block 562). The application 506 may then use the information electronic appliance 500 provides to it, based at least in part on what interpreter 508 has told it about the content information (block 564). For example, the descriptive data structure 200 may provide characteristics about the way application 506 should handle the information 102. Descriptive data structure 200 can, for example, tell application 506 to always display a certain field (e.g., the author or copyright field) and to never display other information (e.g., information that should be hidden from most users). DDS 200 can

also provide complete presentation or “visualization” information so that an information provider can, for example, control the look and feel of the information when it is displayed or otherwise rendered. Descriptive data structure 200 may provide encodings of other characteristics in the form of metadata that can also be used by application 506 during a process of creating, using or manipulating container 100. The DDS 200 can be used to generate a software program to manipulate rights management structures. For example, a DDS 200 could serve as the ‘instructions’ that drive an automated packaging application for digital content or an automated reader of digital content.

Example Description(s) Provided by Descriptive Data Structure

Figure 6 shows one example of how a descriptive data structure 200 may describe and define an arbitrarily complex, information structure such as, for example, an hierarchical container 100. In this particular example, container 100 includes properties 600(1), 600(2). Property 600(1) may include n attributes 602(1), 602(2) ... 602(n). Property 600(2) may include any number of

attributes 604(1), 604(2), and it may also include an additional
property 606. Property 606 may, in turn, include its own attributes
608(1), 608(2) Associated descriptive data structure 200 may be
organized as a tree structure list 250 providing a recursive structure
5 to reflect the recursive structure of the contents of container 100. For
example, list 250 may include "branches" in the form of "property"
descriptors 252(1), 252(2) corresponding to properties 600(1),
600(2). Each property descriptor 252 may, in turn, include a list 254
of attributes and may include additional property descriptors 256 in
10 the same recursive, hierarchical arrangement as is reflective of the
example content container structure. DDS 200 may be used to
describe arbitrarily complex, hierarchical or non-hierarchical data
structures of any dimension (1 to n).

Figure 6A shows that descriptive data structure 200 can be
15 used in conjunction with any kind of information such as, for
example, events or methods defining an "atomic transaction" such as
a real estate transaction. In this Figure 6A example, a container 100
includes one or more descriptive data structures 200 and associated
control set(s) 316 relating to a sequence of "events" 700 that define a

real estate transaction. The DDS 200 may, for example, include a number of different entries 200A-200N pertaining to each different "event" within the transaction (e.g., "offer", "acceptance", "purchase/sales", "inspection", "mortgage", etc.). These entries 200A-N may, for example, define where in container 100 the event can be found. The entries 200A-200N may also include metadata that provides additional characteristics corresponding to the event (for example, how certain information related to the event should be displayed).

10 **Example Descriptive Data Structure Formatting**

Figure 7 shows an example of how descriptive data structure 200 may be formatted. As mentioned above, descriptive data structure 200 may comprise a list such as a linked list. Each list entry 260(1), 260(2), ... may include a number of data fields including, for

15 example:

- an object name field 262,
- one or more metadata fields 264 (which may be part of and/or referenced by the descriptive data structure); and

- location information 266 (which may be used to help identify the corresponding information within the container data structure 100).

The object name field 262 may include a constant that may
5 corresponds to or describes a type of information. For example,
object name field 262 may act as a “handle” to the content or data; it
may be an indirect reference to the content or data; and/or it may be
used to look up the content or data. The following are examples of
object names:

10 General Purpose Object Names

NUMBER

STRING

DATE

TITLE

15 DESCRIPTION

AUTHOR

PROVIDER

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Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	

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SECTION

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The DDS 200 may include or reference any type of data or metadata. In one example, the DDS 200 uses the object name field 262 to point to or refer to metadata. This metadata can define certain characteristics associated with the object name. For example, such metadata may impose integrity or other constraints during the creation and/or usage process (e.g., “when you create an object, you must provide this information”, or “when you display the object, you must display this information”). The metadata 264 may also further describe or otherwise qualify the associated object name.

In one preferred example, the DDS 200 uses object name 262 to refer to metadata stored elsewhere – such as in a container 100. This referencing technique provides several advantages. For example, one situation where it may be useful to store the metadata in a secure container 100 separately from DDS 200 is in situations where it is desirable to make the DDS readily accessible to an outside application but to protect the associated metadata. For example, consider the case of handling web spider queries. A web spider may

query the DDS 200 for a particular object name 262. If the object name is found, then the web spider may request the corresponding metadata. The web spider may have ready access to the metadata, but may only be able to access the associated metadata from the

5 container 100 under appropriate conditions as controlled by a corresponding secure electronic appliance 500 based on associated rules 316. As another example, storing metadata separately from the DDS 200 may allow the same DDS to be used with different metadata in different contexts. Suppose for example that a DDS 200

10 contains an Object Name, for example KEYWORDS. When DDS 200 is associated with container 100A, then the DDS Object Name KEYWORDS refers to container 100A's KEYWORDS metadata. Conversely, if later this same DDS 200 is associated (e.g., packaged with) a different container 100C, then the DDS Object Name

15 KEYWORDS refers to container 100B's KEYWORDS data.

Although it is preferred to use object name 262 to refer to metadata stored elsewhere, there may be other instances where there is a need or desire to explicitly include metadata within the DDS 200. For purposes of illustration, Figure 7 shows an example DDS 200

that includes metadata field 264 and also refers to metadata within a container 100 using the object name 262. Either or both techniques may be used.

5 The DDS 200 thus allows value chain participants to protect the integrity of content, by enabling the specification of integrity constraints. DDS 200 integrity constraints provide a way to state rules about the content. For example, DDS 200 can specify that an article of a newspaper cannot be viewed without its headline being viewed. The corresponding integrity constraint can indicate the rule
10 'if there is an article, there must also be a headline'. Another example is a photograph that is part of a magazine and the credit that goes with it. The integrity constraint rule provided by DDS 200 might be 'do not present this photograph without its associated credit'.

15 DDS integrity constraints give value chain participants a tool for protecting the use of the DDS 200, ensuring that content represented by a particular DDS contains all the essential components--that it is representative of the DDS. This gives

provides a way to set up conventions and enforce standards of use.

There are many possible integrity constraints. The following are a few examples:

- Required: a is required as part of the content
- 5 • Optional : a is an optional component of the content
- Required relationship: if a is present, then b must be present, or if a is present b, c and d must be present. Conversely, if b is not present, then a is not allowed to be present. Relationships in this category are 1:m where $m > 0$.
- 10 • Optional relationship: If a is present b may or may not be present. If b is present, then a is guaranteed to be present. Relationships in this category are 1:n, where $n \geq 0$.
- Repetition: a must occur n times where $n > 1$. This could be specified with ranges of values, etc.
- 15 • Other rules and/or requirements.

Metadata 264

Example Graphical Interface For Creating Descriptive Data Structures

Figure 8 shows an example descriptive data structure creation graphical user interface 312. In this example, the graphical user interface 312 may prompt the user for the object name. In addition, the graphical user interface 312 may provide options for specifying the associated metadata 264. The options shown in Figure 8 may, for example, include:)

- “construction type” metadata (upon object construction, the information is required; upon object construction, the object creation tool is to always or never prompt for the information);
- display metadata (e.g., always display the associated information (e.g., for copyright notices, author names and the like) or always or never make the information visible; and/or
- layout “hints” and field definitions (e.g., text, text block, integer, file, image or other data type).

The above metadata descriptions are non-limiting examples. Other metadata characteristics and attributes may be used.

Example Process Using Descriptive Data Structures

Figure 9 shows one example arrangement for using the infrastructure described in co-pending related U.S. patent application serial no. 08/699,712 (referenced above) for descriptive data structures 200. The arrangement shown in Figure 9 may be useful in a number of different contexts. For example, a provider 600 of descriptive data structures 200 may want to know which descriptive data structures 200 are the best liked by his customers so he or she can improve the quality of his products. Or, a provider 600 may charge customers for using descriptive data structures 200 on a per use or other basis. In still another example, some descriptive data structures 200 or classes of DDS 200 may be restricted to use only by authorized users or classes of authorized users.

Figure 9 shows a DDS provider 600 who delivers a DDS 200 and an associated control set 316 to a value chain participant 602. Controls 316 may provide rules and associated consequences for controlling or otherwise affecting the use or other aspects of what value chain participant 602 can do with DDS 200. The controls 316 and DDS 200 may be packaged within a container 100. Value chain

participant 602 may get the container 100 containing DDS 200
directly from DDS provider 600; alternatively, the provider can
provide it a rights and permissions clearinghouse 604 and participant
602 and get it from the clearinghouse (or elsewhere) (see container
5 100B).

Value chain participant 602 can use DDS 200 to author content
102. Participant 602 can package content 102 with associated
controls 316A in a container 100A. Participant 600 may, if he
desires, include DDS 200 and associated controls 316a, 316b with
10 content 102 in the same container – or depend on the provider 600
and/or rights and permissions clearinghouse 604 to independently
deliver the DDS and its controls to end users 606 in another container
100c for example:

End users 606(1), ..., 606(n) use DDS 200 (in accordance with
15 controls 316) in conjunction with content 102 (for example, to read,
browse or otherwise access the container content). Controls 316,
316A may require user appliances to provide usage data 610 to a
usage clearinghouse 612. The usage clearinghouse 612 can provide

usage data 610A related to access and/or usage of DDS 200 to DDS provider 600, and may independently provide usage data 610B related to access and/or usage of content 102 to value chain participant 602.

5 Descriptive Data Structures Can Be Used to Achieve A Degree of Interoperability Between Rights Management Environments

Descriptive data structures 200 provided in accordance with the present invention can provide a degree of interoperability
10 between source and target rights management environments, and/or to provide a bridge to achieve at least some degree of interoperability between a rights management environment and the outside world.

Different rights management environments may have
15 substantially incompatible mechanisms for defining rights pertaining to an object. Descriptive data structures 200 can provide at least a partial bridge to achieve a degree of compatibility and interoperability. For example, a provider that defines an object within a source rights management environment may create a

descriptive data structure for use by processes within one or more target rights management environments. For example, an object creator or other provider can specify, within a descriptive data structure 200, certain rules, integrity constraints and/or other

- 5 characteristics that can or should be applied to the object after it has been imported into a target rights management environment. The target rights management environment can choose to selectively enforce such rules, constraints and/or other characteristics depending on the degree to which it can trust the source environment. For
- 10 example, objects imported from an EDI system employing X.12 security may be more trustworthy than objects presented from environments with lesser (or no) security.

- In another example, a provider that creates an object outside of any rights management environment can create a descriptive data
- 15 structure 200 for use if and when the object is imported into one or more rights management environments. The target rights management environment(s) can use such descriptive data structure(s) to help efficiently understand and handle the object. Further, a descriptive data structure created within a rights

management environment can be exported to one or more applications outside of the rights management environment and used to assist the application(s) in interpreting exported content or other information.

5 Figure 10A shows an example of how descriptive data structures 200 may be used to provide interoperability. In the Figure 10A example, a DDS creation tool 800 creates a DDS 200 that includes one or more target data blocks 801. In one example, the DDS creation tool 800 may be based on, and/or incorporate some or
10 all of the capabilities of layout tool 300 and provide interoperability capabilities in addition to features associated with layout tool 300. In another example, DDS creation tool 800 may not incorporate any of the capabilities of layout tool 300, and may create DDS 200 solely for interoperability purposes. DDS creation tool 800 may, for
15 example, be an application program with a graphical user interface, a background process that only displays a user interface when being configured by a user, a portion of an operating system, a portion of a computer's firmware, a server process that may act independently or as part or all of a "gateway" between one system and another (e.g., a

public network and a private network, two or more private networks, a local area network and a wide area network, etc.), or any other desirable implementation or integration.

Target data block 801 may provide information used to provide interoperability with a particular target environment 850. A single DDS 200 can, in one example, provide interoperability with N different target environments 850 by including N target data blocks 801(1), ...801(N) each corresponding to a different target environment 850(1), ... 850(N).

In this example, each target data block 801 includes rule (control) information. Different target data blocks 801 can provide different rule information for different target environments 850. The rule information may, for example, relate to operations (events) and/or consequences of application program functions 856 within the associated target environment 850 such as specifying:

- permitted and/or required operations;
- nature and/or extent of operations permitted and/or required operations; and/or

- consequences of performing permitted and/or required operations.

The target data block 801 may also include additional information if desired that gives directions to a DDS parser 852 and/or a translator 854 within a corresponding target environment 850.

Figure 10B shows one detailed example of how target information may be organized within DDS 200. In this example, DDS creation tool 800 creates a DDS header 805 that references one or more target record headers 807. DDS header 805 may, for example, include a “number of targets” field 809 indicating the number of target data blocks 801 within the DDS 200, a “offset to first target data portion” field 811 that provides the location of the first target data block 801(1) within the DDS 200, a source message field 812A that identifies the source environment, and an optional creator seal 812B that may be used to verify the integrity and authenticity of the DDS 200. Source message field 812A (which can be

optional) may include a source ID that may be used to help verify the source environment of DDS 200, and an optional source seal (that may or may not be present in the source message). Each target data block 801 within DDS 200 may
5 begin with a target record header 807 including a "target ID" field 813, a "length" field 815, a "offset to next target data portion" field 817, an optional creator seal 819, and an optional source message 821. The "target ID" field 813 may specify a unique identification number or value corresponding to the
10 associated target data block 801 and/or identifying the intended target environment(s), the "length" field 815 may specify the length of the target data block 801, and the "offset" field 817 may specify the location (relative or absolute) of the next target data block 801 within the DDS 200 (and may take on a
15 null value for the last target data block).

The optional creator seals 812B, 819 (and source seals) may be cryptographic seals that help to ensure that the DDS 200 and target records 801, respectively, have not be altered since they were created, and also the identity of the DDS 200's

creator and/or source. The optional source messages 812C and 821 may be information that helps to ensure that a target environment knows which source environment created DDS 200.

5 Referring again to Figure 10A, DDS creation tool 800 may, upon creating the DDS 200, cryptographically seal it and each target data block 801 for integrity using appropriate cryptographic processes, for example by first running a cryptographic hash function (e.g., SHA, MD5, etc.) on the data and then encrypting the resulting
10 hash value using a private key of the DDS creator associated with an asymmetric cryptosystem (e.g., RSA, El Gamal, etc.). If sealing is used, the DDS creator preferably should ensure that the public key associated with the encrypting private key is certified (e.g., encrypted with a private key of a certifying authority) and available for use by
15 target environments to validate the seal (e.g., by including a certificate in DDS 200, publishing the certificate on a public network, etc.)

SECRET

If source messages 812C, 821 are used, they should preferably represent information provided by the source environment that may help a target environment identify the source environment, and further may also help to ensure that the DDS 200 was actually created

5 by the source environment (and therefore may, for example, be trusted to the extent that the source environment is trusted). For example, a source environment may have a protected processing environment (PPE) of the form described in the above referenced Ginter, et al. patent application. Certain of such PPEs may have

10 cryptographic keys (e.g., a private key of a public key/private key pair) available that may be used to encrypt a cryptographic hash taken of the DDS header 805 or target block header 807, as appropriate. In such an example, a target environment would need to acquire a corresponding cryptographic key (e.g., a public key of a

15 public key/private key pair) using trusted techniques (e.g., delivery in a certificate signed by a trusted certifying authority) in order to evaluate such a source message. In another example, DDS creation tool 800 may have been equipped with cryptographic keys when it was manufactured, and may use these cryptographic keys instead of

keys from a PPE, although generally this technique would be more susceptible to tampering by an experienced computer hacker and might therefore be somewhat less trusted by target environments.

In addition, or alternatively (for example, if cryptographic techniques are not appropriate or desired), the source message may contain a unique identifier that corresponds to the source environment.

The DDS creation tool 800 (see Figure 10A) may then package the resulting DDS 200 into a secure container 100 along with an associated object 830. In another example, DDS creation tool 800 may embed DDS 200 within, or otherwise associate the DDS with, an object 830' that provides a method for releasing the DDS to the target environment parser 852. The DDS 200 and its associated object 830 may then be delivered to one or more target environments 850 for processing.

Target environment parser 852 (and/or translator 854) may, for example, be part of an application program, part of an operating system, or part of a utility program used by, or in conjunction with,

an application program and/or an operating system. The target environment parser 852 receives the DDS 200 and parses it to locate the target data block 801(k) corresponding to the target environment 850 (k). Parser 852 may then determine, from the corresponding target data block 801, the rules the target data block contains. Parser 852 preferably understands enough about the structure of DDS 200 to find (e.g., using the header information shown in Figure 10B) the appropriate target data block 801 corresponding to it, and also to understand the rules within the target data block. The target environment parser 852 doesn't need to understand any additional rules 316 that may be packaged within container 100 or otherwise delivered with object 830, but it may use any such additional rules if desired (e.g., when it finds no target data block 801 within DDS 200 for the particular target environment 850 (for example, if it is capable of understanding some other target data block 801 whose rules are based on a published specification and/or standard)).

The target environment parser 852 may obtain applicable target rules from target data block 801 and provide these rules to application program functions 856. Application program functions

856 may define any operation pertaining to object 830 such as for example:

- cut
- copy
- 5 • print
- paste
- save
- change
- delete
- 10 • any other operation.

The target rules provided by parser 852 may be used, for example, to permit, require and/or prevent certain operations; to define the extent to which certain operations can be performed (e.g., limit number of copies, define extent of cut, the rules that should be applied to cut information in subsequent use, etc.); and/or to define

15 the consequences of performing a particular operation (e.g., charge

the user for printing or otherwise using and/or accessing all or part of object 830, maintain records of the time and/or number of such operations performed, etc.).

Parser 852 may also, or alternatively, provide some or all of

5 the rules it obtains from target data block 801 to other arrangements for applying the rules such as, for example, the "other rights management functions" block 858. Block 858 may provide any kind of rights management functions. Translator 854 may be used if

10 "other rights management" block 858 to understand the rules. As one example, translator 854 may be used to further elaborate, parameterize and/or secure the rule information obtained from target data block 801 so they are more or fully compatible with the "other rights management functions" block 858.

15 A useful data structure definitional method and arrangement has been described in connection with its most practical and presently preferred example embodiments. The present invention is not to be limited to those embodiments, but on the contrary, is intended to

encompass variations and equivalents as defined within the spirit and scope of the claims.

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